Q1) Determine the steady-state error for the system in Figure 1 for a step input [5 marks]

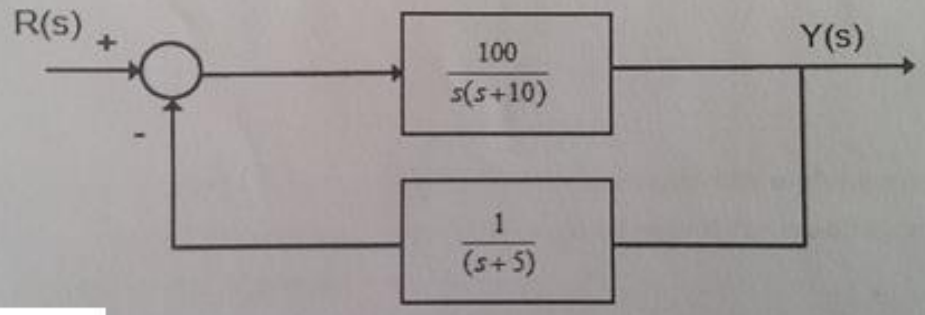

Figure 1

Q2) A simplified form of the open-loop transfer function of an airplane with an autopilot in the longitudinal mode is

$$\frac{K(s+a)}{s(s-b)(s^2+2\zeta\omega_n s+\omega_n^2)}$$

Such a system involving an open-loop pole in the right-half s plane may be stable. Using the root locus technique, find the range of gain K for stability when a = b = 1, ζ= 0.5, and ω_n= 4. [5 marks]

Q3) Consider the system shown in Figure 3. The system operates with a percentage overshoot of 20%. Design a PID controller so that the system can operate with a peak time that is two-thirds that of the uncompensated system and with zero steady-state error for a step input. [10 marks]

Hint: Peak Time $Tp = \dfrac{\pi}{\omega_n\sqrt{1-\zeta^2}}$

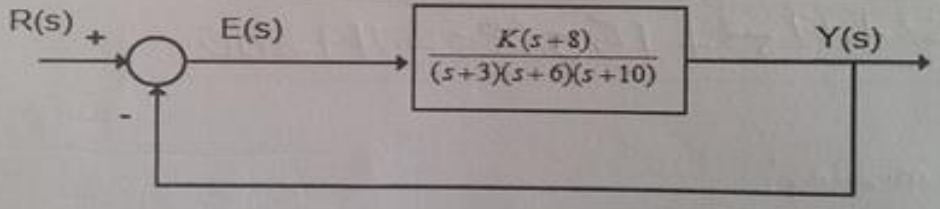

Figure 3